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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
SONG, MATTHEW J	
ART UNIT	**PAPER NUMBER**
1765	

DATE MAILED: 11/06/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/700,236	ZHANG ET AL.	
	Examiner	**Art Unit**	
	Matthew J Song	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 August 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-14* is/are pending in the application.

4a) Of the above claim(s) ______ is/are withdrawn from consideration.

5)☐ Claim(s) ______ is/are allowed.

6)☒ Claim(s) *1-14* is/are rejected.

7)☐ Claim(s) ______ is/are objected to.

8)☐ Claim(s) ______ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on ______ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on ______ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ______ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ______ .
4) ☐ Interview Summary (PTO-413) Paper No(s). ______ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 8/18/2003 has been entered.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-14 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 1 recites, "forming a MOCVD-grown periodic or no-periodic inactive intermediate multi-layered buffer" in lines 3-4. The instant specification is silent to the buffer being active or inactive. There is no explicit teaching in the instant specification that the multi-layered buffer is inactive.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 1-14 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 1 recites, "forming a MOCVD-grown periodic or no-periodic inactive intermediate multi-layered buffer" in lines 3-4. The definition of "inactive" is unclear because the instant specification does not define "inactive". Applicant's instant specification teaches the claimed method can be used in a light emitting device (pg 2), which suggests the "inactive" buffer can be used in an active device. Also, the "inactive" layer performs the function of accommodating strain arising from lattice mismatch (pg 5); therefore appears to be active.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

6. Claim 12 is rejected under 35 U.S.C. 102(e) as being anticipated by Ishikawa et al (US 5,977,565).

Ishikawa et al discloses a layer **103** grown by MOCVD includes one or more pairs of a thin GaN layer and a thin InGaN and an additional GaN layer. Ishikawa et al also

discloses the GaN layers have a thickness of about 1-10nm, typically 4 nm, and the InGaN layers have a thickness of about 1-5 nm, typically 2 nm (col6, ln 35-55). Ishikawa et al also teaches a second cladding layer **104** of p-type $In_xAl_yGa_{(1-x-y)}N$, thereon (col 8, ln 40-65)

Ishikawa et al discloses alternating GaN and InGaN layers but is silent to their lattice constants and energy band gaps. However, GaN and InGaN inherently have different lattice constants and energy band gaps because GaN and InGaN have different compositions.

Ishikawa et al is silent to the deposition temperatures. However, applicant is reminded claim 12 is directed to a product, although claim 12 specifically recites process limitations, the patentability determination of a product-by-process claim is based on the patentability of the product and does not depend on its method of production (MPEP 2113).

Ishikawa et al is silent to the multi-layered buffer is inactive. A recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. The structure taught by Ishikawa et al is similar in thickness and material, as applicant; therefore inherently would be capable of performing the claimed intended use. See *In re Casey*, 152 USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963).

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 1-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Razeghi et al (5,831,277) in view of Shakuda (US 5,838,029).

Razeghi et al discloses confinement layer comprising a superlattice structure having from about 5 to about 500 alternating layers of AlGaN and GaN with a total thickness of less than 5000 angstroms on sapphire substrate, this reads on applicant's periodic or non-periodic buffer (col 4, ln 1-67). Razeghi et al also discloses layers of GaN have a thickness of about 10 to about 30 angstroms (1-3 nm) and the layers of AlGaN have a thickness of about 10 to about 100 angstroms (1-10 nm), note claims 6-7. Razeghi et al also discloses a contact layer of GaN doped with silicon magnesium, thereon (col 5, ln 5-67). Razeghi et al also discloses growth of the layers by MOCVD and GaInN may be substituted for AlGaN in the confinement layer (col 4, ln 1-67). Razeghi et al also discloses the growth temperature for AlGaN is 800-1000°C, InGaN is 700-800°C and GaN is 800-1000°C.

Razeghi et al does not disclose the group III-nitride compound is formed at a temperature higher than the first temperature

In a method of forming gallium nitride, note entire reference, Shakuda teaches forming a 0.01 to 0.2 micrometer thick low temperature buffer layer of a gallium nitride type compound semiconductor layer on a substrate at a low temperature of 400-700°C

and forming a 2 to 5 micrometer thick gallium nitride type compound semiconductor layer at higher temperature of 700-1200°C, so that the low temperature buffer layer relaxes the lattice mismatch between the substrate and the low temperature buffer layer and prevents crystal defects or dislocations (col 4, ln 1-67 and col 1, ln 30-45). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Razeghi et al with Shakuda's low temperature buffer layer followed by a high temperature growth to prevent crystal defects in surface layers.

The combination of Razeghi et al and Shakuda is silent to the buffer layer is inactive. The Examiner has interpreted inactive to mean that it is not an active layer used in a light emitting device. The superlattice buffer taught by the combination of Razeghi et al and Shakuda is used as confinement layers of an active layer of GaN ('277 col 25-35). The superlattice taught by the combination of Razeghi et al and Shakuda is separate from the active layer of GaN; therefore not being an active layer reads on applicant's inactive.

Referring to claim 1, the combination of Razeghi et al and Shakuda teach a thickness of 1-3 nm for GaN and a thickness of 1-10 nm. The combination of Razeghi et al and Shakuda does not teach the claimed range of 2-6 nm. Overlapping ranges are held to be obvious (MPEP 2144.05). Also GaN and AlGaN inherently have different energy gaps and lattice constants because GaN and AlGaN have different compositions.

Referring to claim 2, Razeghi et al GaN doped with silicon magnesium, this reads on applicant's p-type group III nitride compound semiconductor because magnesium is a well known p dopant for GaN.

Referring to claim 3-4, Razeghi et al teaches a superlattice of 10 angstroms of GaN and 100 angstrom of AlGaN.

Referring to claim 5, the combination of Razeghi et al and Shakuda teach AlGaN and InGaN can be substituted.

Referring to claim 7, the combination of Razeghi et al and Shakuda teach a first growth temperature of 400-700°C and a second growth temperature of 700-1200°C. Temperature is well known in the art to be a result effective variable. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Razeghi et al and Shakuda by optimizing the temperature by conducting routine experimentation of a result effective variable (MPEP 2144.05).

Referring to claim 8, the combination of Razeghi et al and Shakuda does not teach 3 periods or repeating AB units and a total layer thickness is approximately 24 nm. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Razeghi et al and Shakuda by optimizing the number of period and thickness by conducting routine experimentation.

Referring to claim 9-10, the combination of Razeghi et al and Shakuda teach AlGaN can be substituted with InGaN.

Referring to claims 13-14, the combination of Razeghi et al and Shakuda teach a total thickness of less than 5000 angstroms (500 nm). Overlapping ranges are held to be obvious (MPEP 2144.05).

9. Claims 1-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schetzina (US 5,670,798) in view of Shakuda (US 5,838,029).

Schetzina discloses a multiple quantum well including alternating layers of aluminum nitride or aluminum gallium nitride and gallium nitride and the thickness of

the layers of gallium nitride increase from adjacent a first layer to opposite the first layer (col 7, ln 1-67). Schetzina also discloses group III-V nitride materials are deposited by MOCVD (col 10, ln 1-40) on a sapphire substrate **132**, note Fig 5. Schetzina also discloses a sequence of GaN quantum wells having a thickness of 10, 7, 5, 4, 3, 2 and 1 monolayers (5, 3.5, 2, 1.5, 1, and 0.5 nm, respectively), where a monolayer is 5 angstroms, separated by about 15-25 angstrom (1.5-2.5 nm) AlN barriers (col 13, ln 1-67). Schetzina also discloses a multiple quantum well of alternating layers of AlGaN and GaN and the thickness of the GaN increases from adjacent AlGaN and the thickness of AlGaN remains constant (col 12, ln 1-67). Schetzina also teaches p-GaN layer **124a** on the multiple quantum well (Fig 5).

Schetzina does not disclose the group III-nitride compound is formed at a temperature higher than the first temperature

In a method of forming gallium nitride, note entire reference, Shakuda teaches forming a 0.01 to 0.2 micrometer thick low temperature buffer layer of a gallium nitride type compound semiconductor layer on a substrate at a low temperature of 400-700°C and forming a 2 to 5 micrometer thick gallium nitride type compound semiconductor layer at higher temperature of 700-1200°C, so that the low temperature buffer layer relaxes the lattice mismatch between the substrate and the low temperature buffer layer and prevents crystal defects or dislocations (col 4, ln 1-67 and col 1, ln 30-45). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Schetzina with Shakuda's low temperature buffer layer followed by a high temperature growth to prevent crystal defects in surface layers.

The combination of Schetzina and Shakuda is silent to the buffer layer is inactive. The Examiner has interpreted inactive to mean that it is not an active layer used in a light emitting device. The buffer taught by the combination of Schetzina and Shakuda is separate from the active region **112** ('798 Fig 5); therefore reads on applicant's inactive.

Referring to claim 1, the combination of Schetzina and Shakuda teaches a GaN quantum wells having a thickness 5, 3.5, 2, 1.5, 1, and 0.5 nm separated by about 1.5-2.5 nm AlN barriers. Overlapping ranges are held to be obvious (MPEP 2144.05).

Referring to claim 7, the combination of Schetzina and Shakuda teach a first growth temperature of 400-700°C and a second growth temperature of 700-1200°C. Temperature is well known in the art to be a result effective variable. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Razeghi et al and Shakuda by optimizing the temperature by conducting routine experimentation of a result effective variable (MPEP 2144.05).

Referring to claim 8, the combination of Schetzina and Shakuda does not teach 3 periods or repeating AB units and a total layer thickness is approximately 24 nm. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Schetzina and Shakuda by optimizing the number of period and thickness by conducting routine experimentation.

Referring to claim 13-14, the combination of Schetzina and Shakuda teaches a GaN quantum wells having a thickness 5, 3.5, 2, 1.5, 1, and 0.5 nm separated by about 15-25 angstrom (1.5-2.5 nm) AlN barriers. The total thickness can be determined by summing the thickness to obtain a total thickness of 25.5 nm for an AlN thickness of 2 nm. Overlapping ranges are held to be obvious (MPEP 2144.05).

Response to Arguments

10. Applicant's arguments filed 8/18/2003 have been fully considered but they are not persuasive.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., an electrically active component and an inactive buffer between the functional component and the substrate that aids in structurally connecting the functional component to the otherwise incompatible substrate (pg 4)) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

In response to applicant's argument that Ishikawa does not teach an inactive buffer layer, a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art. See *In re Casey*, 152 USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). Ishikawa teaches a similar structure and materials, as claimed by applicant; therefore the layered structure taught by Ishikawa would inherently be capable of performing the claimed use.

Applicant's arguments regarding the Razeghi/Shakuda rejection are noted but are not found persuasive. Applicant alleges that the layers about an AlN buffer are the active semiconductor structure layers and not buffer layers. This is viewed as mere attorney argument, which lacks evidence; therefore is not found persuasive. Furthermore, Razeghi teaches an AlN buffer layer, as suggested by applicant, an **active** GaN, and superlattice of GaN and AlGaN (col 5, ln 20-40). The active GaN is separate from the superlattice of GaN and AlGaN; therefore reads on applicant inactive layer because it is not active.

Applicant's arguments regarding the Schetzina/Shakuda rejection are noted but are not found persuasive. Applicant alleges Schetzina teaches an integrated heterostructure device with a single layer buffer **134** and does not teach the claimed inactive multilayered buffer. Schetzina does teach a single layer buffer, as suggested by applicant, however Schetzina also teaches a quantum well of GaN and AlGaN, which reads on applicant's inactive intermediate buffer layer because the quantum well is located between two semiconductor layers **124a**, **114a** and **114b, 124b**, note Fig 5.

In response to applicant's argument that Schetzina does not teach a multi-layer buffer, a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art. See *In re Casey*, 152 USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). The multilayered quantum well of GaN and AlGaN used for confinement (col 13, ln 45-67) has a similar structure and is composed of a similar

material, as applicant; therefore would inherently be capable of performing the claimed intended use of a buffer layer.

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Chen et al (US 6,495,867) teaches a multi-layer buffer layer comprising InGaN, AlGaN and GaN (claim 1).

Shmagin et al (US 5,875,052) teaches MOCVD of a quantum well of 3 nm thick InGaN layers and 5 nm thick GaN layers with a capping layer of AlGaN (col 5).

Koide et al (US 6,040,588) discloses a method of making a semiconductor device, where a 3.5 nm thick barrier layer **5a** made of GaN is formed at 900°C, by MOVPE and a 3.5 nm thick quantum well layer **5b** made of $In_{0.16}Ga_{0.84}N$ is formed at 750°C and repeating this process (col 6, ln 1-67).

Tischler (US 5,585,648) teaches a strained-layes (Al,Ga)N superlattice as a buffer layer between a substrate and an epitaxial layer (col 13, ln 30-45)

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 703-305-2667. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song
Examiner
Art Unit 1765

MJS

ROBERT KUNEMUND
PRIMARY PATENT EXAMINER
A.U. 1765